a review of The pullback equation for differential forms by Csato, Gyula; Dacorogna, Bernard; Kneuss, Olivier

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The pullback equation for differential forms. (English) Zbl 1247.58003

Progress in Nonlinear Differential Equations and Their Applications 83. Basel: Birkhäuser (ISBN 978-0-8176-8312-2/hbk; 978-0-8176-8313-9/ebook). xi, 436 p. (2012).

This book studies the pullback equation for differential forms

$$\varphi^*(g) = f.$$

Given two differential k-forms f and g, the authors discuss the equivalence of such forms, which turns out to be a system of nonlinear first-order partial differential equations for the unknown map φ. In more physical terms, the problem of equivalence of forms is to be seen as a problem of mass transportation.

The problem studied here is a particular case of the equivalence of tensors, which has attracted considerable attention, though the pullback equation for differential forms is of a quite different character compared to those for symmetric tensors such as Riemannian metrics.

The problem has been extensively studied in the cases $k = 2$ and $k = n$, but much less when $3 \leq k \leq n-1$. The problem of finding normal forms such as seen in the Darboux theorem, the Pfaff normal form theorem, etc. has been of utmost importance in symplectic and contact geometry. The principal emphasis of this book is put upon regularity and boundary conditions. Special attention has been paid to getting optimal regularity, which requires estimates for elliptic equations and fine properties of Hölder spaces.

The book will presumably appeal to both geometers and analysts. To avoid intricate notation of geometry, the authors restrict their attention to domains in $\mathbb{R}^n$, though all results generalize easily to manifolds with or without boundary.

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MSC:

58A10	Differential forms (global analysis)
15A75	Exterior algebra, Grassmann algebras
35Fxx	General first order PDE
58Axx	General theory of differentiable manifolds

Keywords:

Hodge-Morrey decomposition; contractible set; Dacorogna-Moser theorem; Gaffney inequality; Poincaré lemma; Sard theorem; boundary conditions; regularity; symplectic geometry; contact geometry; Darboux theorem; Pfaff normal form; pullback equations; first-order partial differential equations; mass transportation; equivalence of tensors

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